

Deep-sea data measurements and gaps identified by the NOAA Office of Ocean Exploration and Research

Katharine Egan

Associate Scientist

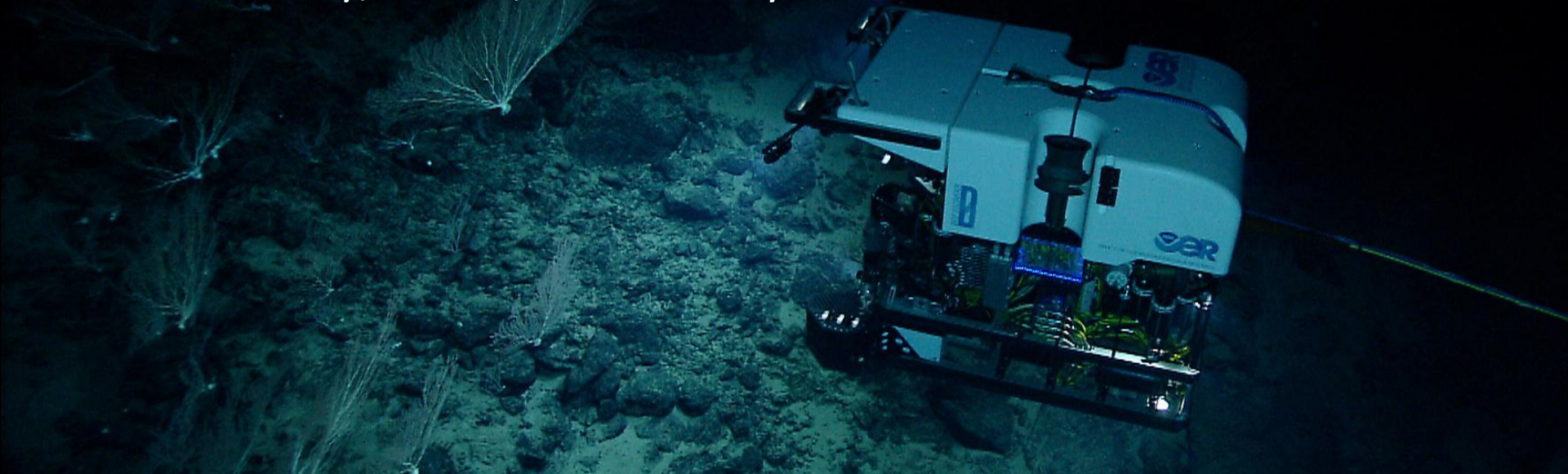
NOAA Office of Ocean Exploration and Research

DSCRTP Seminar Series

April 23, 2020

Who are we?

The NOAA Office of Ocean Exploration and Research is the only federal program dedicated to exploring our deep ocean, closing the prominent gap in our basic understanding of U.S. deep waters and seafloor and delivering the ocean information needed to strengthen the economy, health, and security of our nation.



Ocean Exploration Paradigm

- **Why:** Establish a “baseline” of information about the deep ocean
- **How:** NOAA Ship *Okeanos Explorer*, grants to other explorers, and partnerships
- **Who:** Goal is to provide decision makers with the information they need
- **Open access to expeditions and data is integral to our program**

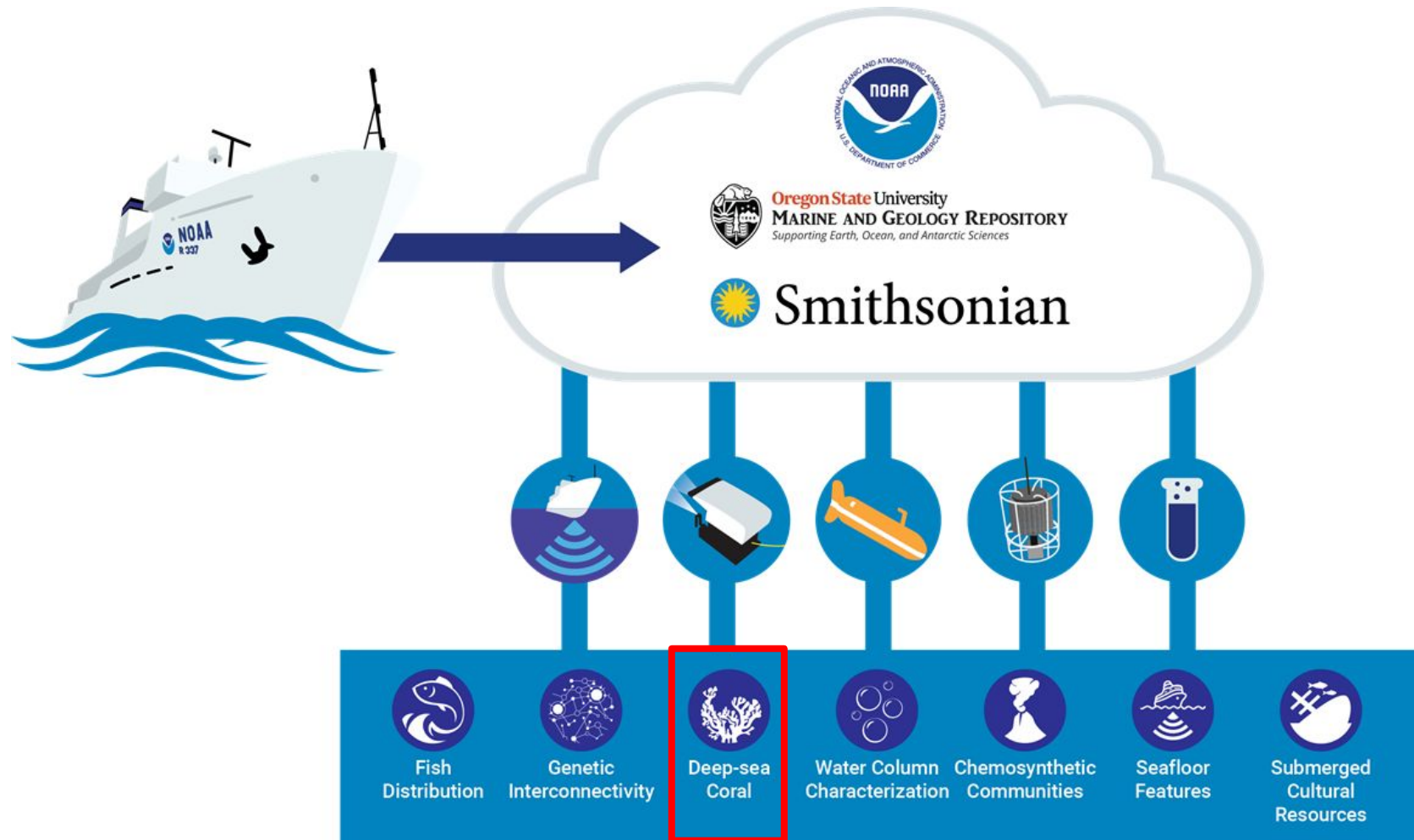
Primary Observations Team

- Internal working group was formed to define a specific set of oceanographic measurements desired for exploratory observations
- Data products are referred to as **primary observations**
- Focused on data collected via the *Okeanos Explorer*

Goals of the Primary Observations Team

1. Identify and create a summary document of all *Okeanos Explorer* measurements/data collected
2. Obtain input from stakeholders to improve data collections
 - a. Survey community needs based on published stakeholder recommendations and identify data gaps
 - b. Evaluate feasibility and provide recommendations for incorporating data gaps into standard operations

Relevance to Deep-Sea Coral Research



Windows to the Deep 2019



Goals of the Primary Observations Team

1. **Identify and create a summary document of all *Okeanos Explorer* measurements/data collected**
2. Obtain input from stakeholders to improve data collections
 - a. Survey community needs based on published stakeholder recommendations and identify data gaps
 - b. Evaluate feasibility and provide recommendations for incorporating data gaps into standard operations

Current Data Collections

- Took inventory of current measurements
- Grouped into four operational categories:
 - Mapping
 - CTD rosette
 - Ship-based
 - ROV
- Identified frequency of operation and rate of collection



MAPPING OPERATIONS

		XBT	MULTIBEAM BATHYMETRY/ BACKSCATTER	SUBBOTTOM PROFILER	EK60/EK80
COLLECTION RATE DURING OPERATION		2 - 6 hours	continuous	continuous	continuous (based on sonar frequency)
WATER COLUMN	BIOLOGICAL		X		X
	CHEMICAL/ PHYSICAL	X	X		X
SEAFLOOR/SUB-SEAFLOOR	BIOLOGICAL				
	CHEMICAL/ PHYSICAL		X	X	X
	GEOLOGICAL		X	X	X
	ARCHAEOLOGICAL		X	X	



CTD ROSETTE OPERATIONS

		CTD-O	TURBIDITY & OXIDATION REDUCTION POTENTIAL AND FLUOROMETER	WATER SAMPLES	CTD ROSETTE SUMMARY FORM
COLLECTION RATE DURING OPERATION		continuous	continuous	≤12/cast	1/cast
WATER COLUMN	CHEMICAL/ PHYSICAL	X	X	X	X



SHIP-BASED MEASUREMENTS

		METOC SENSORS	THERMOSALINOGRAPH	ADCP
COLLECTION RATE DURING OPERATION		continuous	continuous	continuous
ATMOSPHERE	BIOLOGICAL			
	CHEMICAL/ PHYSICAL	X	X	
WATER COLUMN	BIOLOGICAL			
	CHEMICAL/ PHYSICAL			X



ROV OPERATIONS

		HD VIDEO WITH LASERS FOR SCALE	ANNOTATIONS	PRIMARY BIOLOGICAL SAMPLES	PRIMARY ROCK SAMPLES	ASSOCIATED BIOLOGICAL SAMPLES	CTD-O	TURBIDITY & OXIDATION REDUCTION POTENTIAL	WATER SAMPLES	DIVE SUMMARY FORM
COLLECTION RATE DURING OPERATION		continuous (turned off for close-up imaging)	variable	≤8/dive	≤3/dive	variable	continuous	continuous	≤5/dive	1/dive
WATER COLUMN	BIOLOGICAL	X	X	X		X		X	X	X
	CHEMICAL/ PHYSICAL						X	X	X	X
SEAFLOOR/ SUB-SEAFLOOR	BIOLOGICAL	X	X	X	X	X		X	X	X
	CHEMICAL/ PHYSICAL	X			X		X	X	X	
	GEOLOGICAL	X	X		X	X		X		X
	ARCHAEOLOGICAL	X	X							X

Deep-Sea Data Needs Addressed by the NOAA Office of Ocean Exploration and Research

By Katharine Egan, Amanda N. Netburn, James W.A. Murphy, Margot Bohan, Adrienne Copeland, Megan Cromwell, Clint Edrington, Stephen R. Hammond, David McKinnie, Derek Sowers, Nathalie Valette-Silver, and Daniel Wagner

- Summary of the E/V *Nautilus*, NOAA Ship *Okeanos Explorer*, and R/V *Falkor* 2019 field seasons
- Check out the article on the data collected through *Okeanos Explorer* operations
- [Available online now](#)

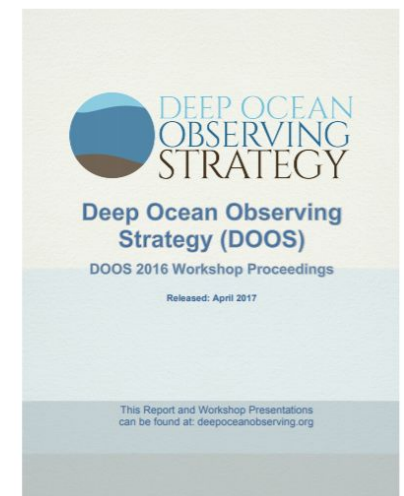
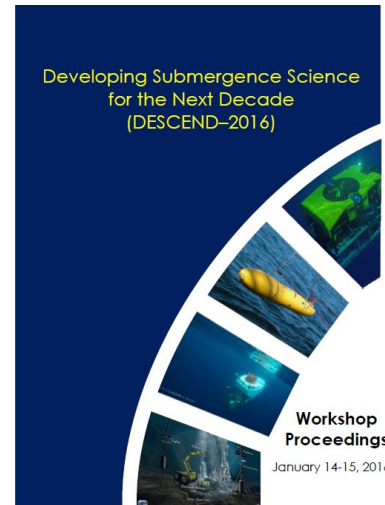
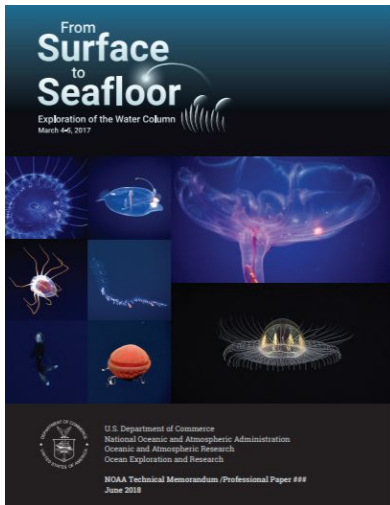


Goals of the Primary Observations Team

1. Identify and create a summary document of all *Okeanos Explorer* measurements/data collected
2. Obtain input from stakeholders to improve data collections
 - a. **Survey community needs based on published stakeholder recommendations and identify data gaps**
 - b. Evaluate feasibility and provide recommendations for incorporating data gaps into standard operations

Data Gap Analysis

Literature review conducted of published community reports synthesizing deep-ocean data needs (seven reports)



Data Gap Analysis

- A list of deep-sea data types was compiled:
 - A data type was identified as critical to measure
 - That data type is not currently collected by OER
- Reports were also assessed for overlapping data types

Data Gap Analysis

- Total: **53 data gaps** identified
- **10 data gaps** were identified in three or more community reports



DATA GAPS

		INORGANIC MACRONUTRIENTS, NITRATE/NITRITE, SILICATE, PHOSPHATE	MICROBIAL BIOMASS AND DENSITY	PHYTOPLANKTON & ZOOPLANKTON BIOMASS AND DIVERSITY	SUSPENDED PARTICULATES, PARTICULATE ORGANIC MATTER, DISSOLVED ORGANIC CARBON	DISSOLVED INORGANIC CARBON	OCCURRENCE AND DISTRIBUTION OF LARGE MARINE VERTEBRATES	PH, ALKALINITY, REDOX	FLUXES: GEOTHERMAL, BOTTOM BOUNDARY, PARTICULATE, SEDIMENT, NUTRIENTS	BULK BIODIVERSITY	MICROPLASTIC ABUNDANCE AND DIVERSITY
	NUMBER OF REPORT MENTIONS	5	5	5	4	3	3	3	3	3	3
WATER COLUMN	BIOLOGICAL		X	X			X			X	
	CHEMICAL/ PHYSICAL	X			X	X		X	X		X
SEAFLOOR/ SUB-SEAFLOOR	BIOLOGICAL		X							X	
	CHEMICAL/ PHYSICAL								X		X
	GEOLOGICAL								X		

Goals of the Primary Observations Team

1. Identify and create a summary document of all *Okeanos Explorer* measurements/data collected
2. Obtain input from stakeholders to improve data collections
 - a. Survey community needs based on published stakeholder recommendations and identify data gaps
 - b. Evaluate feasibility and provide recommendations for incorporating data gaps into standard operations**

Feasibility Assessment

- Develop a **feasibility assessment**
- Used to evaluate the feasibility of incorporating new measurements, instruments, or processes into OER standard operations to fill data gaps
- Assessments are completed in consultation with experts in that field

Feasibility Assessment

- Background and justification
- Relevance to NOAA and OER missions
- Materials
- Methods and protocols
- Cost
- Personnel
- Time
- Data management and accessibility
- Permitting
- Environmental risk

Feasibility Assessment: eDNA

- **Data gaps:** Plankton diversity, occurrence of marine vertebrates, bulk biodiversity
- **Feasible:** Equipment to collect water samples and adequate lab space
- **Challenges:** Repository to store samples, pipeline to conduct analyses, personnel

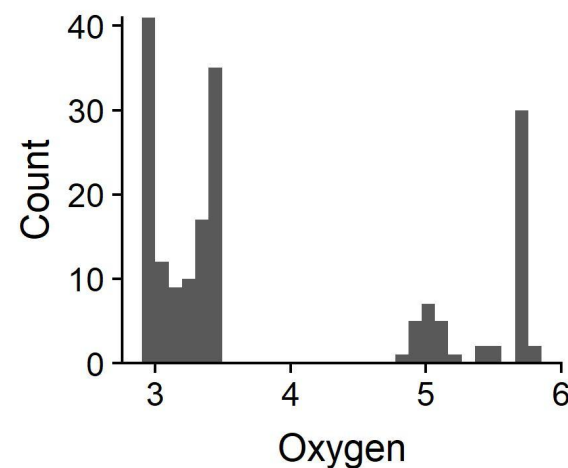
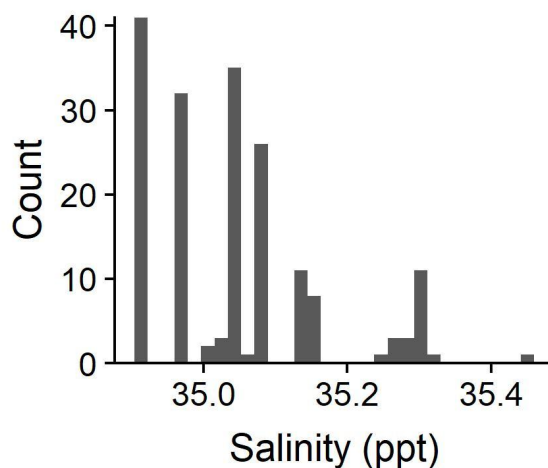
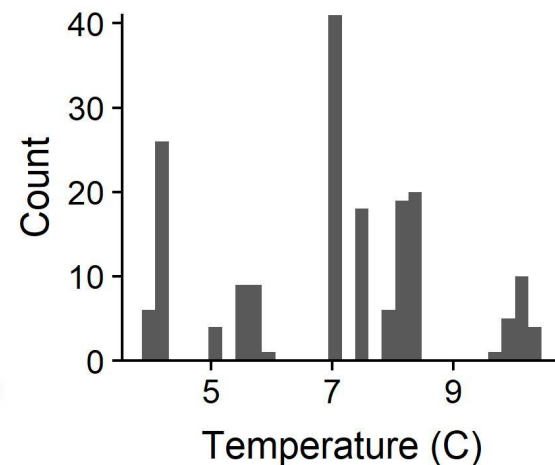
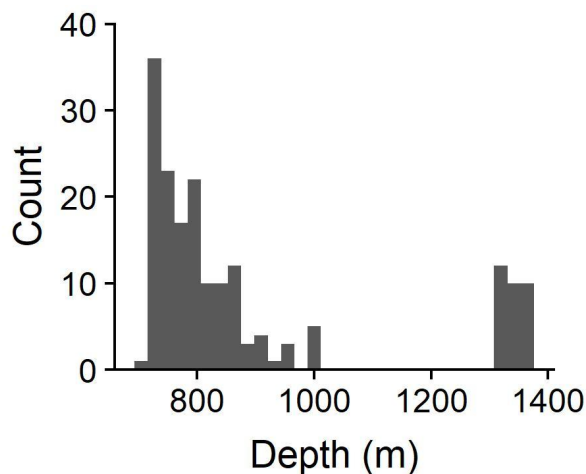
eDNA trial runs on the *Okeanos Explorer*

An underwater photograph of a coral reef. The coral is a branching, light-colored species, possibly Acropora, with many small, pointed polyps. The background is dark, suggesting deep water. The text "Stay tuned!" is overlaid in the center in a white, bold, sans-serif font.

Stay tuned!

Next Steps: Data Synthesis Product

Bamboo coral
counts plotted
with ROV CTD
data from the
Windows to the
Deep 2019
expedition



Acknowledgements

Primary Observations Team (OER): Amanda Netburn, James Murphy, Margot Bohan, Adrienne Copeland, Megan Cromwell, Clint Edrington, Steve Hammond, David McKinnie, Derek Sowers, Nathalie Valette-Silver, Daniel Wagner

And thank you to: Kasey Cantwell (OER), Sam Chin (CUNY), Meredith Everett (NWFSC), Rachel Gulbraa (OER), Matthew King (OER)

Questions?

Katharine Egan
katharine.egan@noaa.gov

Data Gap Analysis Literature

Netburn, A.N., ed. 2018. From Surface to Seafloor: Exploration of the Water Column. Workshop Report, Honolulu, HI, March 4–5, 2017. NOAA Office of Ocean Exploration and Research, Silver Spring, MD. NOAA Technical Memorandum OAR OER 003, 34 pp, <https://doi.org/10.25923/rnjx-vn79>.

NOAA OER (National Oceanic and Atmospheric Administration, Office of Ocean Exploration and Research). 2011. NOAA Workshop on Systematic Telepresence-Enabled Exploration in the Atlantic Basin, May 10–11, 2011. Workshop Summary, <https://oceanexplorer.noaa.gov/about/whatwe-do/media/atl-basin-workshop-2011-summary.pdf>.

OET (Ocean Exploration Trust). 2012. Workshop on Telepresence Enabled Exploration of the Caribbean Region, Workshop Summary, November 15-18, 2012, https://12c64cfc-24daf6c1-9c88-d1c9253bf5b1.filesusr.com/ugd/dbd949_88b38984c6b84099b992fff056fcd237.pdf.

OET. 2014. Workshop on Telepresence-Enabled Exploration of the Eastern Pacific Ocean, Workshop Report, December 11–13, 2014, https://12c64cfc-24da-f6c1-9c88-d1c9253bf5b1.filesusr.com/ugd/dbd949_cbbfd390e8da4387b77ed26512f20bfa.pdf.

Data Gap Analysis Literature

Sayre, R.G., D.J. Wright, S.P. Breyer, K.A. Butler, K. Van Graafeiland, M.J. Costello, P.T. Harris, K.L. Goodin, J.M. Guinotte, Z. Basher, and others. 2017. A three-dimensional mapping of the ocean based on environmental data. *Oceanography* 30(1):90–103, <https://doi.org/10.5670/oceanog.2017.116>.

UNOLS (University-National Oceanographic Laboratory System). 2016. Developing Submergence Science for the Next Decade (DESCEND 2016) Workshop Proceedings, January 14–15, 2016. Retrieved from [https://www.unols.org/sites/default/files/DESCEND2 2016 FINALFINAL_small.pdf](https://www.unols.org/sites/default/files/DESCEND2%202016%20FINALFINAL_small.pdf).

Woodall, L.C., D.A. Andradi-Brown, A.S. Brierley, M.R. Clark, D. Connelly, R.A. Hall, K.L. Howell, V.A.I. Huvenne, K. Linse, R.E. Ross, and others. 2018. A multidisciplinary approach for generating globally consistent data on mesophotic, deep-pelagic, and bathyal biological communities. *Oceanography* 31(3):76–89, <https://doi.org/10.5670/oceanog.2018.301>.